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E02B 17/02 , B63B 35/00

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B7A AAAQ ACA A430D1
E1H HEA

(56) Documents Cited
GB 2252996 A EP 0249422 A1 EP 0214730 A2
US 4683832 A

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INT CL^6 B63B 35/00 35/44 38/00 , E02B 17/00 17/02

(54) Transporting offshore structures

(57) A transport structure 1 comprises a barge 2 supported by two pontoons 3,4. The barge 2 is a flooded barge having a ballast system, and is pivotably connected to the pontoons 3,4. To decommission an offshore structure such as a spar the transport structure 1 is moved towards the spar and the barge 2 is caused to pivot about the pontoons 3,4 by appropriate ballasting. The structure to be decommissioned may be attached to the barge when the barge is in a substantially vertical position. The barge loaded with the structure may then be pivoted to a position lying in the horizontal plane just below the surface of the water in which position the structure 1 may transport the offshore structure to the appropriate location.

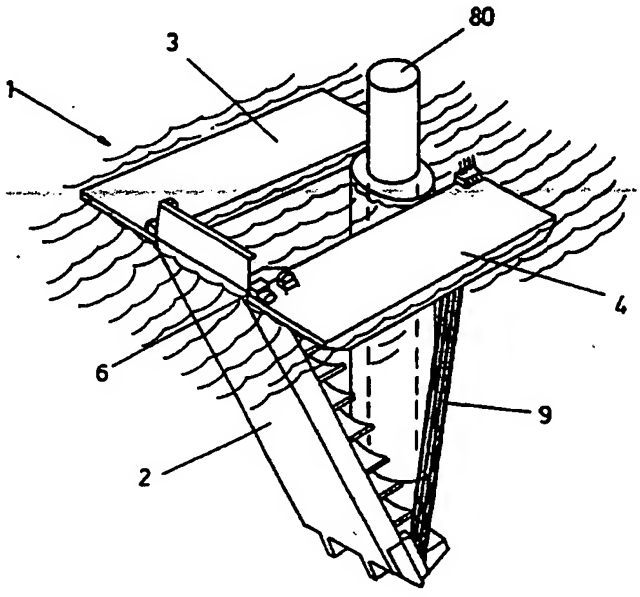

FIG. 12

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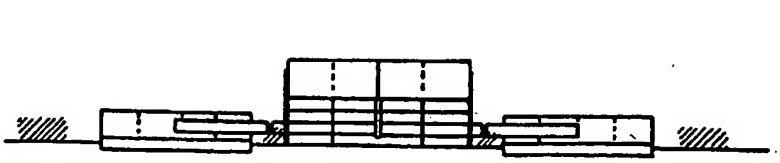

FIG. 4

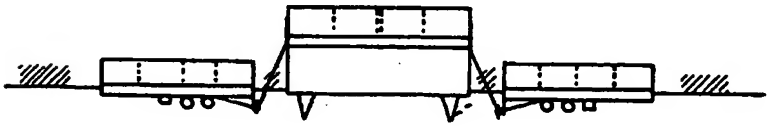

FIG. 3

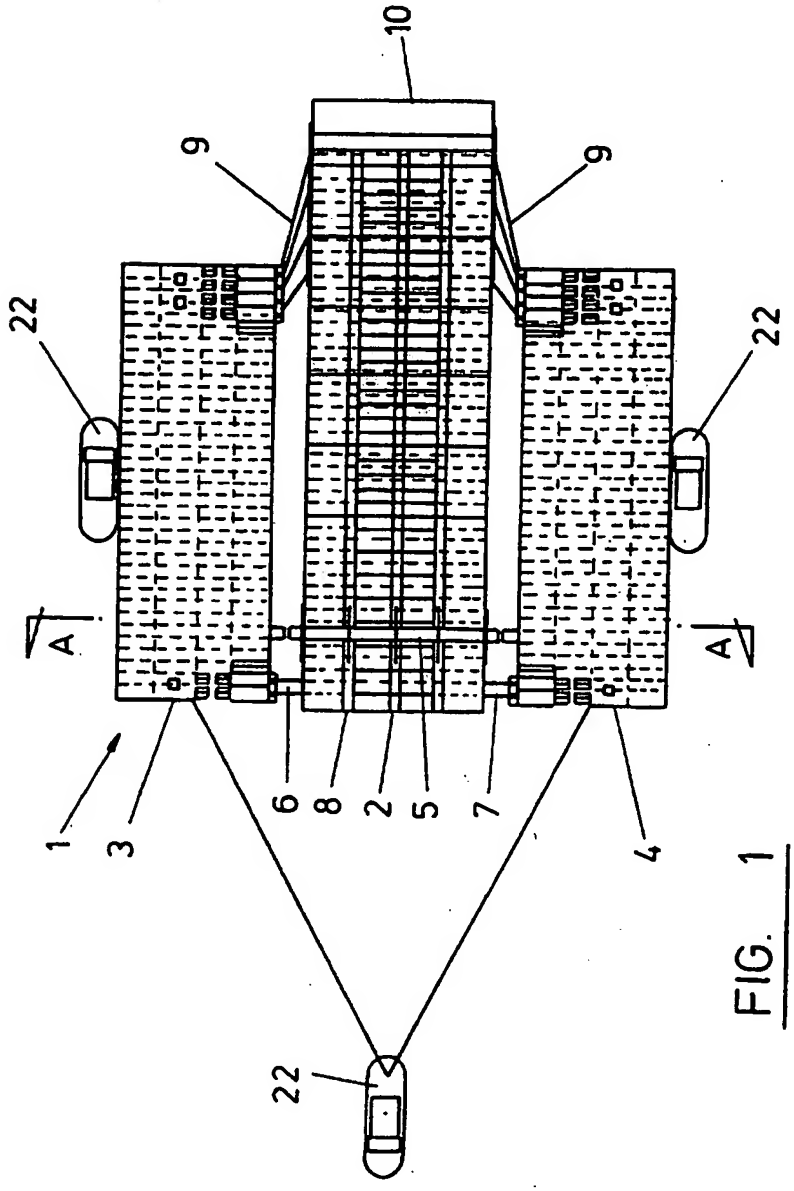

FIG. 1

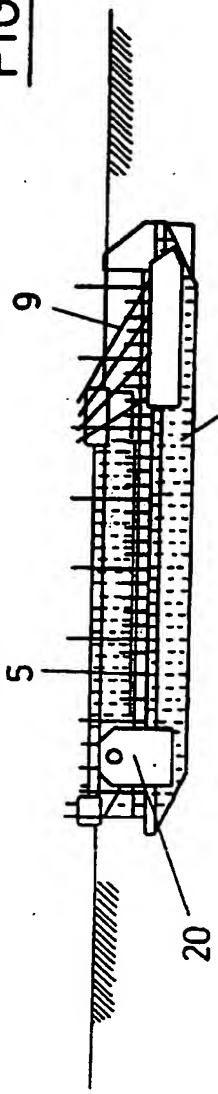

FIG. 2

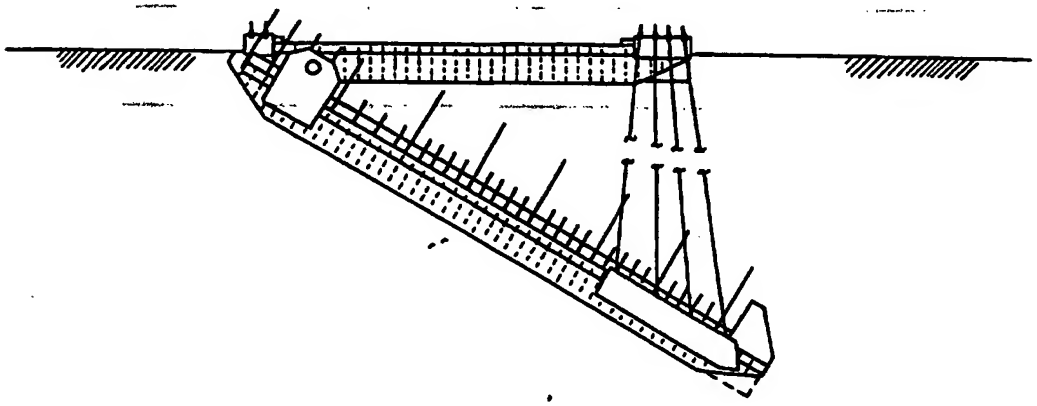

FIG. 5

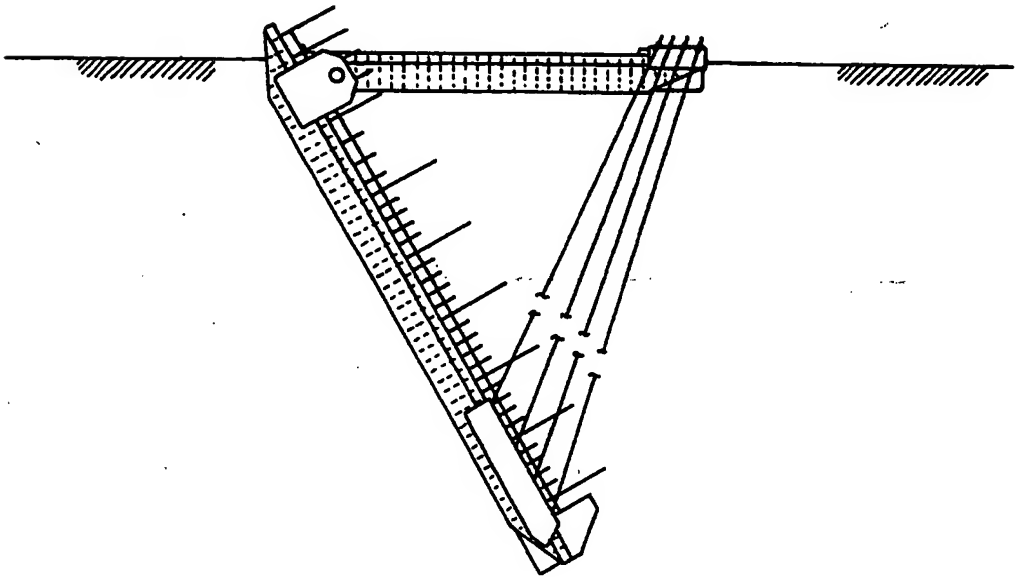

FIG. 6

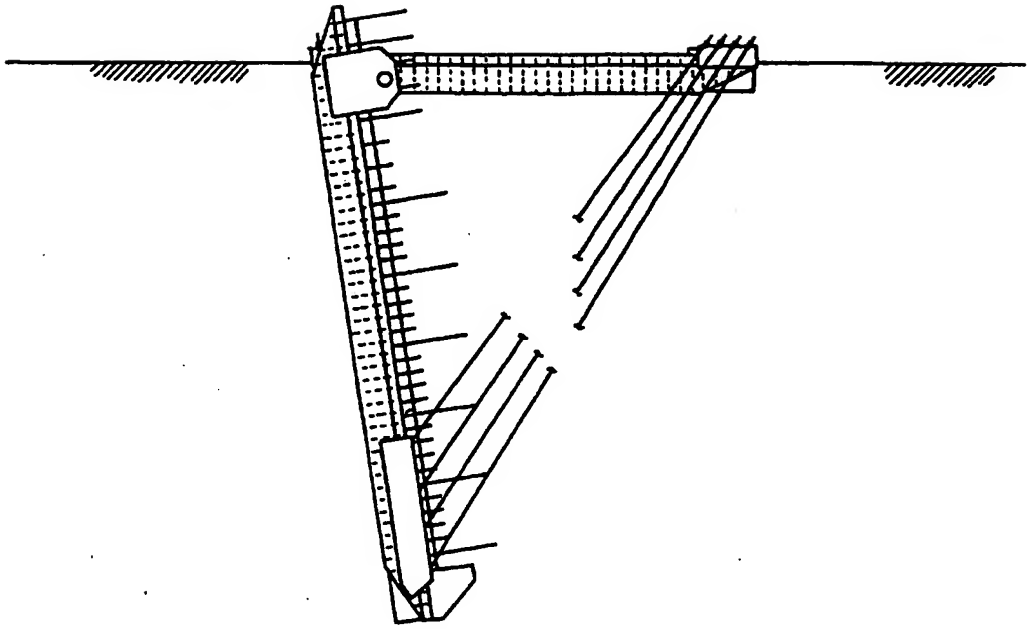

FIG. 7

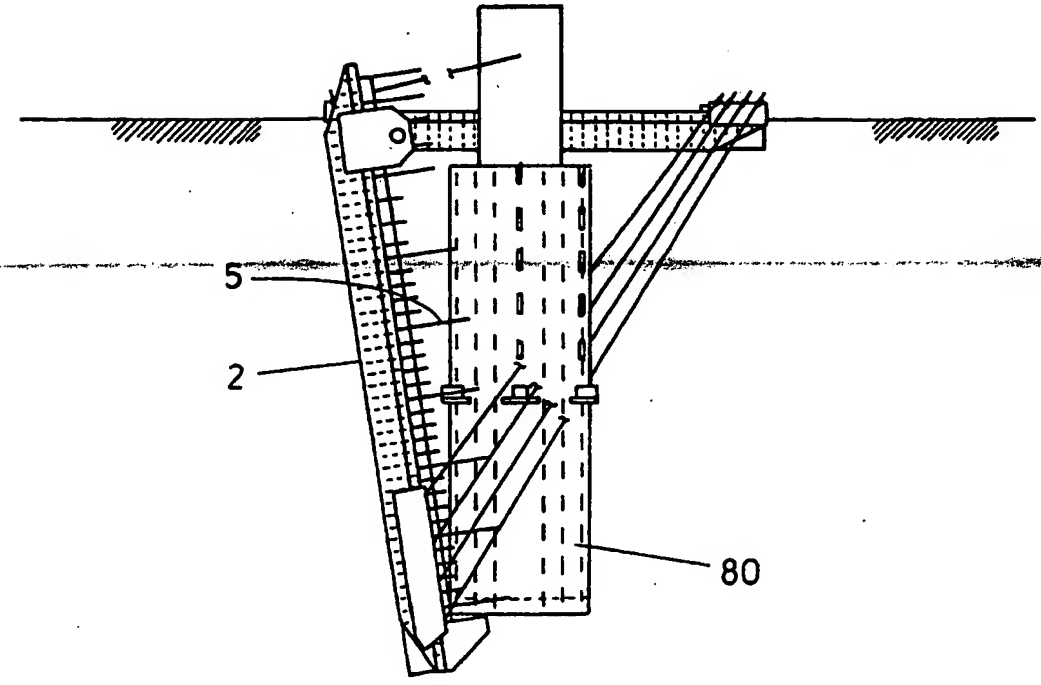

FIG. 8

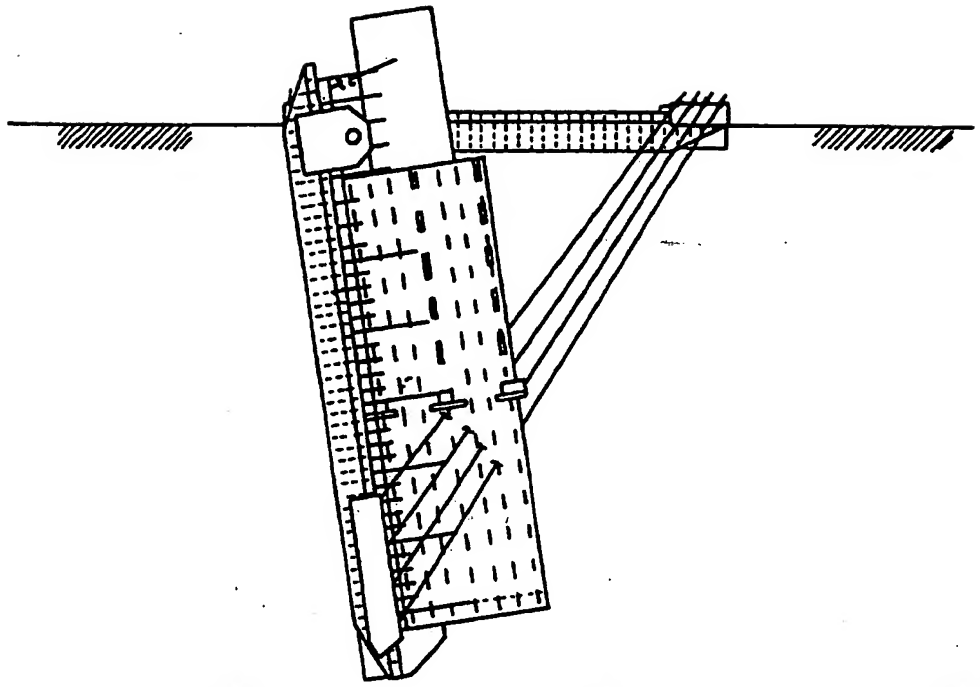

FIG. 9

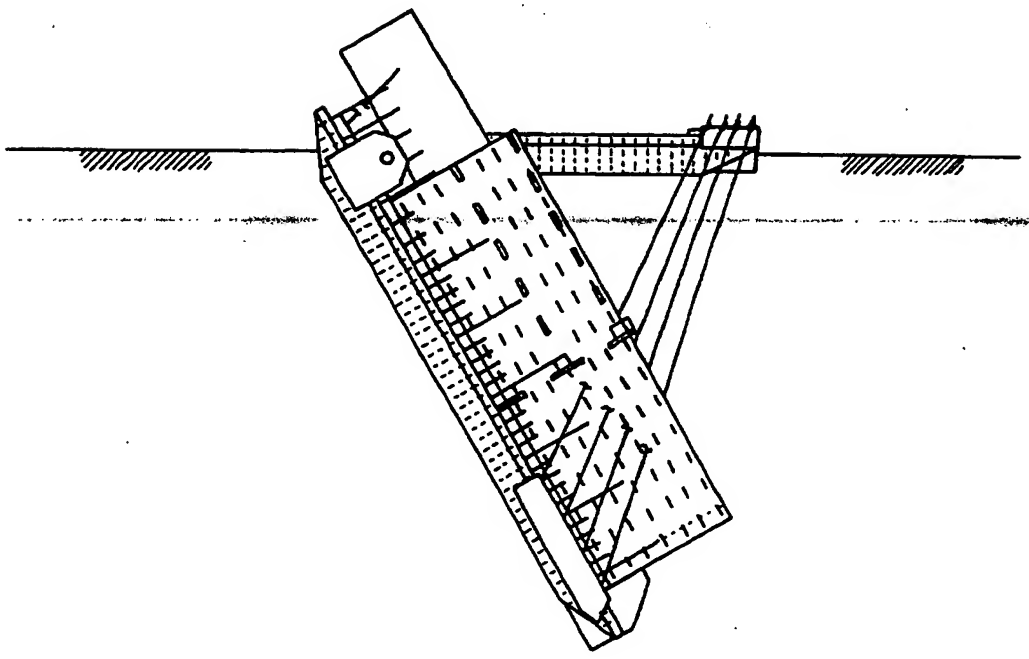

FIG. 10

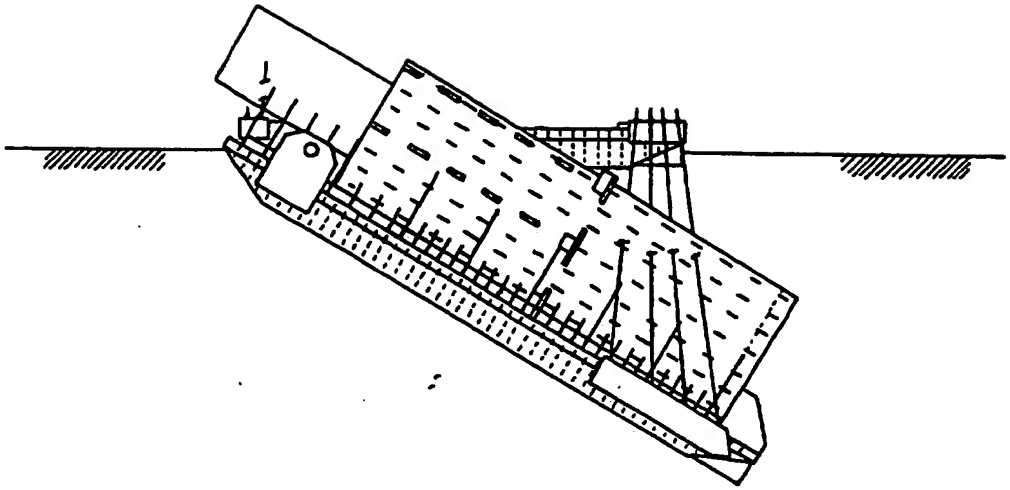

FIG. 11

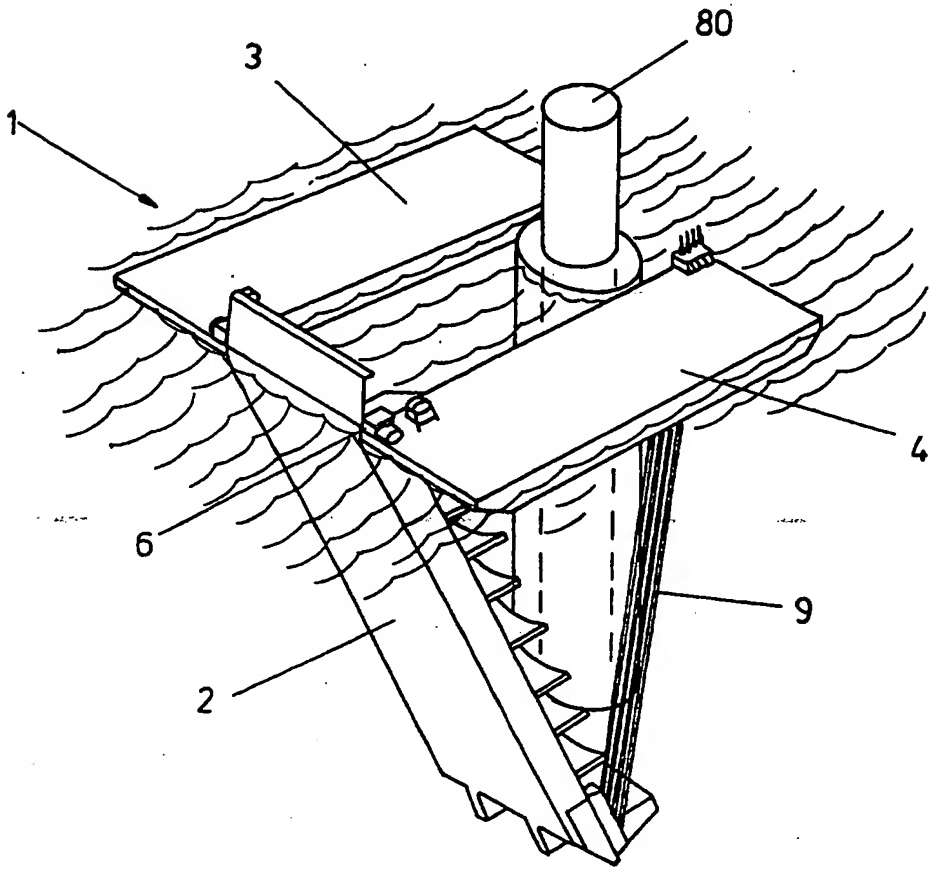

FIG. 12

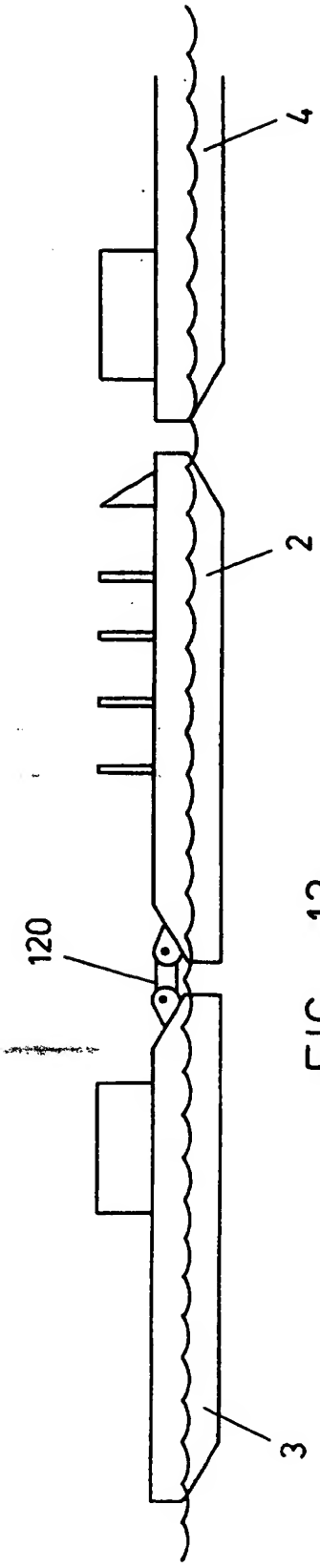

FIG. 13

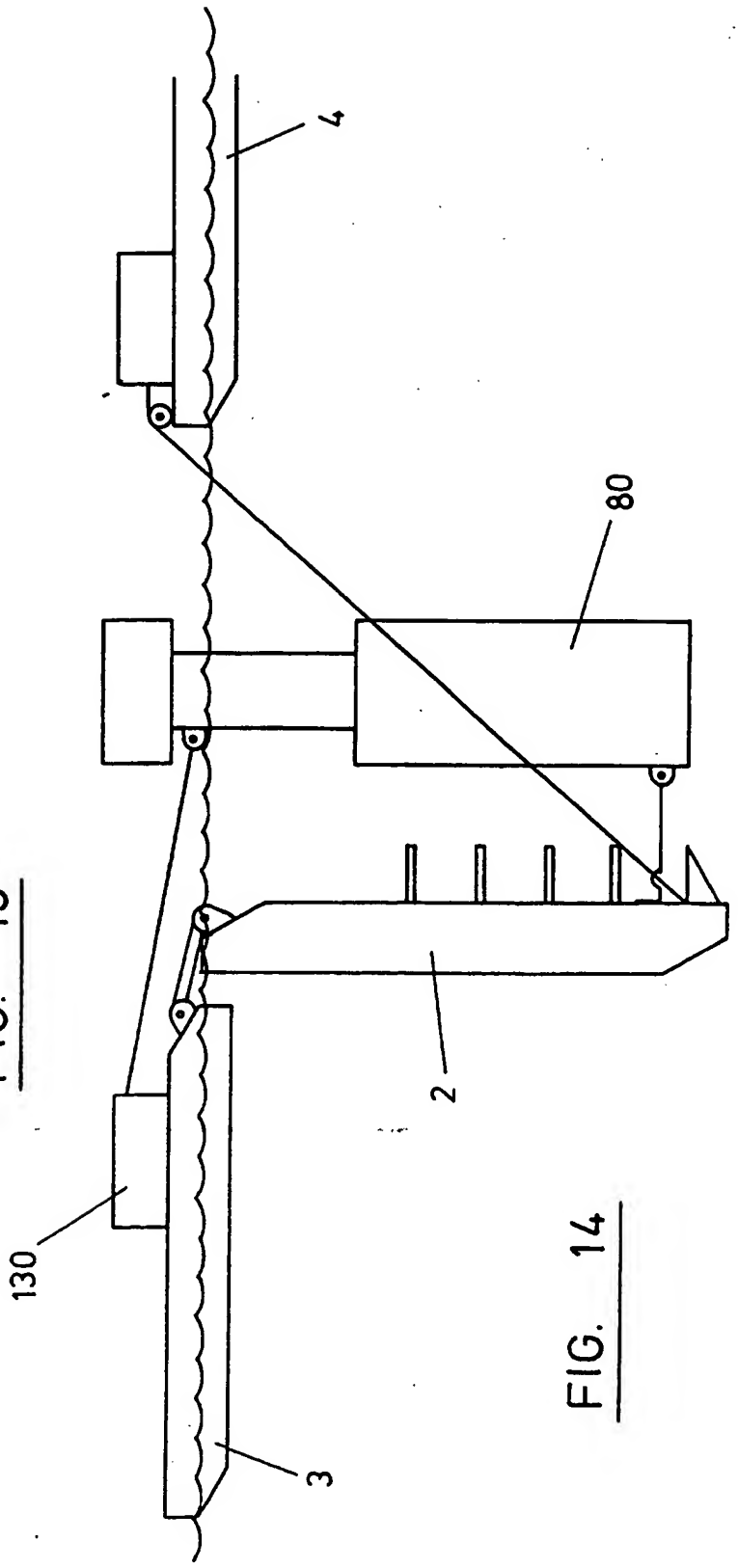

FIG. 14

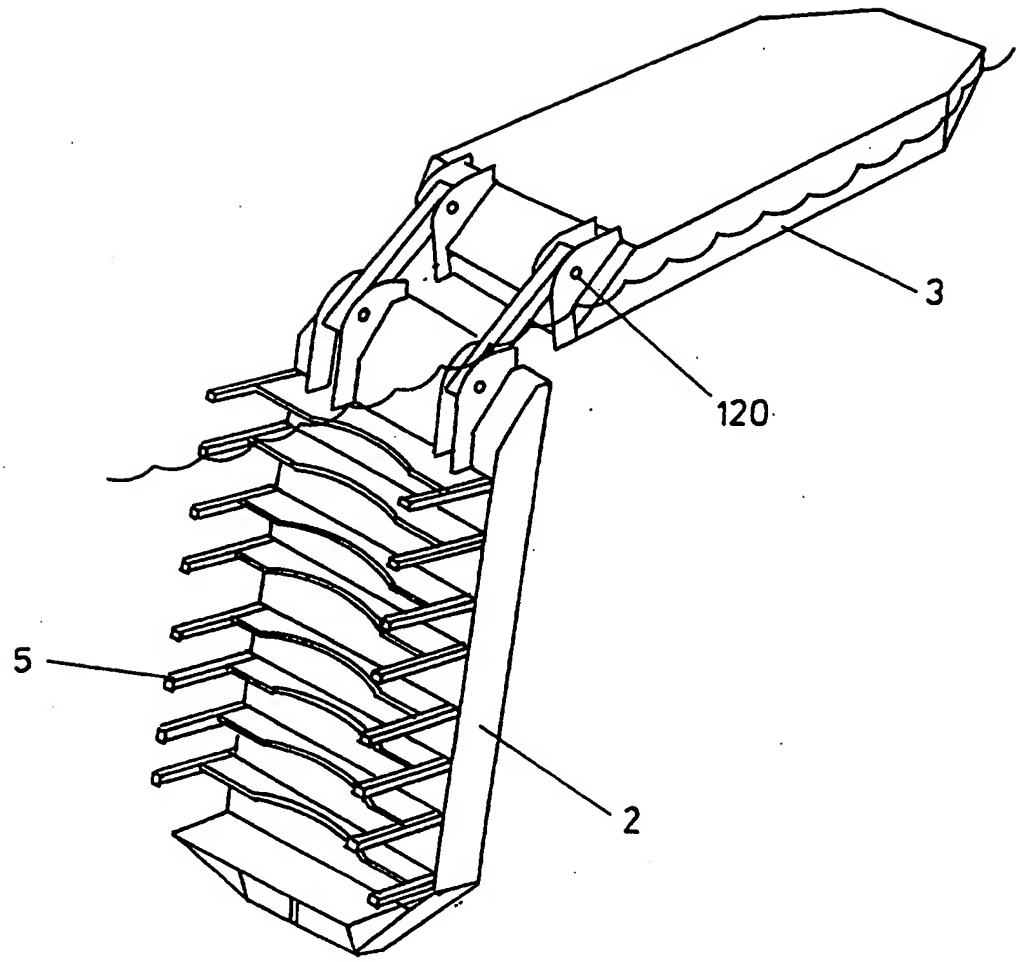

FIG. 15

TRANSPORT STRUCTURE

This invention relates to a transport structure for the transportation of large offshore structures, and particularly, but not exclusively, to a transport structure for moving oil rigs and spars in order to allow for decommissioning of the rigs or spars.

A spar is a structure which forms part of an oil rig. When a deep sea oil well is active, a spar will be moored to the sea bed and will be used to store oil from the oil well before the oil is transported to shore.

When it is no longer possible to drill oil from an oil well or no longer economical to do so, there is a problem relating to the removal of the spar. At the end of the life of the oil field, the spar will contain oil. It is important not to allow oil from leaking into the sea, oil leaks will cause serious environmental damage and pollution.

A spar is a very large structure typically 90 to 100 metres long, approximately 90% of which is typically below water level.

If it is required to decommission such a structure it is necessary to transport the structure to a port or to docks.

Because of the length of a structure such as a spar it is not possible to transport the structure without upending it, because due to the dimensions of the structure it would not be possible to bring it into a dock or port as it would be grounded in relatively shallow waters.

It is known to decommission a spar by initially severing a portion of the spar which is above the water, removing oil and removing the severed portion. This process is repeated along the length of the spar.

A problem with this known method of decommissioning a spar is that it is environmentally dangerous. It may also be dangerous for the personnel who are working on the spar.

Another known method of decommissioning a spar is to use two cranes each of which are supported on support barges. The cranes are used to attach cables to the bottom end of the structure. The cranes are then used to pull the end of the structure up to sea level, thus bringing the structure to a substantially horizontal position at sea level. The structure may then be transferred onto a barge and towed into a port or to docks.

A problem with this known method of decommissioning a spar is that the forces applied to the structure by the crane when the cranes are used to pull the bottom end of the structure up towards the surface of the water can result in structural fragmentation of the spar. This results in oil spillage which is environmentally damaging.

According to a first aspect of the present invention there is provided transport means for transporting an offshore structure from a first location to a second location, the transport means comprising:

support means for supporting the structure, the support means adapted to float in the water having a first end and a second end, and being supported by a pontoon, the support means being pivotably attachable to the pontoon at a pivot point positioned towards the first end of the support means.

Due to the pivoted attachment of the support means to the pontoon the second end of the support means may thus be caused to sink into the water. The dimensions of the support means are such that when the second end of the support means is lowered into the water, the lower end is engageable with a lower end of the structure to be moved.

Once the second end of the support means has engaged with the lower end of the structure, it is caused to return to the surface of the water thus bringing the lower end of the offshore structure thereby upending the structure.

By means of the present invention therefore rather than having to bring the spar to the barge when the barge is lying in a substantially horizontal plane, the barge is lowered into the water such that it has a substantially vertical plane, brought into contact with the spar and then returned to the surface of the water whilst supporting the spar. The barge thus supports the spar during the process of upending the spar. This reduces the stresses and strains applied to the spar during the upending process and reduces the likelihood that the spar will suffer from a structural or mechanical failure which could lead to environmental pollution due to oil spillage.

Preferably, the support means is a barge.

Advantageously, the barge comprises chambers, in order to cause the second end of the barge to sink into the water, water is flooded into the chambers.

Advantageously, the support means comprises a grillage on the surface of the barge which makes contact with the spar. The grillage serves to support and grip the structure during the upending process.

Preferably, the barge is supported by two pontoons. This adds stability to the composite structure.

The pontoons may be positioned at either side of the barge or alternatively at either end of the barge.

Advantageously, the barge is attached pivotably to the pontoons by means of trunnions positioned towards the first end of the barge.

Preferably, the opposite end of the barge is attached to the pontoons by means of strand jacks or winches. Strand jacks or winches are used to allow controlled pivotable movement of the barge relative to the pontoons.

According to a second aspect of the present invention there is provided a method of transporting an offshore structure from a first location to a second location, the method comprising the steps of:

positioning a floating supporting means in the vicinity of an offshore structure;

lowering an end of the support means below the water level to engage with the lower end of the structure, raising the end of the support means with the offshore structure in order to upend the structure onto the barge for removal to a second location.

The invention will now be further described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a plan view of a transport structure according to the present invention;

Figure 2 is a side view of the structure of Figure 1;

Figure 3 is a cross sectional representation of the structure of Figure 1 from the stern of the barge;

Figure 4 is a cross section taken along A-A on Figure 1;

Figures 5 to 7 are schematic representations showing how the second end of the barge of the structure of Figure 1 may be lowered;

Figure 8 is a schematic representation of the structure of Figure 1 showing engagement of the barge with the structure to be moved;

Figures 9 to 11 are schematic representations of the structure of Figure 1 showing raising of the barge back up to sea level once engagement with this bar has occurred;

Figure 12 is a schematic representation of the structure of Figures 1 to 11 showing docking of the spar.

Figures 13 and 14 are schematic diagrams of a second embodiment of the invention in which pontoons are positioned at either end of the barge; and

Figure 15 is a schematic representation of the barge of the embodiment shown in Figures 13 and 14 showing the barge in a substantially vertical position.

Referring to Figure 1 transportation structure according to the first aspect of the present invention is designated generally by the reference numeral 1. The structure comprises a barge 2 supported by two pontoons 3, 4. The barge is a flooded barge having a ballast system. The barge 2 further comprises a grillage 5 erected on a top surface of the barge. The grillage aids recovery of the spar and also aids subsequent transportation of the spar into a port or into docks.

The barge 2 is pivotably connected to the pontoon 3, 4 by means of pivoting trunnions 6, 7 positioned towards a first end 8 of the barge 2.

The barge 2 is further connected to the pontoon 3, 4 by means of strand jacks or winches 9 positioned towards a second end 10 of the barge 2.

To decommission a structure such as a spar, the transport structure 1 moved towards the spar.

The barge 2 and the pontoons 3, 4 are ballasted to their maximum floating draught.

When the structure 1 is in the vicinity of the spar which is to be decommissioned, the barge 2 is ballasted further until it has a nominal negative buoyancy. The barge 2 is held above the water by means of the strand jacks or winches 9. The ballasting of the pontoons 1, 4 is varied according to loading on the strand jacks or winches 9.

In this position, the trunnions 6, 7 may be fully engaged with trunnion sockets 20 in barge 2.

The barge 2 is then caused to pivot about the trunnions 6, 7 from a position lying in a horizontal plane just below the surface of the water to a near vertical position by suitable flooding of tanks in the barge 2 of the trunnion vulcrum. Pontoons 3, 4 are ballasted to maintain correct draught and attitude.

The strand jacks or winches 9 are lowered off to a nominal tension thus allowing the second end 10 of the barge 2 to be lowered. The process of flooding the tanks of the barge 2, ballasting the pontoons 3, 4 and lowering off the strand jacks or winches 9 is repeated until the barge 2 is in any other vertical position. This process is shown in Figures 5 to 7.

Structure 1 is then moved further towards the spar 80 by means of handling tugs 22. The structure 1 is moved such that the spar is positioned between the pontoons 3, 4. The spar is then moved into a docking position in which it engages with the second end of the barge 2 as shown in Figure 8. The spar 80 is held in position by the grillage 5.

The barge now supporting the spar 80 is then returned to the horizontal position in carefully controlled stages. The ballasts of the barges 3, 4 together with the ballasts of the barge 2 are slowly altered in conjunction with altering of the length of the strand jacks or winches so that the barge 2 is eventually returned to the horizontal plane at just below sea

level now carrying the spar 80 which has thus been upended.

Before the spar 80 and the barge 2 can be de-ballasted to a fully floating attitude ready for transportation, the pontoons 3, 4 must be removed from the trunnion supports. As the loading through the trunnions at the bow, and through the strand jacks or winches at the stern gives stability, partial sea fastening of the spar must be carried out before any other further operations are carried out. The primary sea fastening will be achieved by welding to the grillage at, for example, a fifth support.

The barge 2 is then disconnected from the pontoons 3, 4 and is then transported with the spar to an appropriate dock.

A schematic representation of the transport structure described hereinabove is shown in Figure 12. The barge 2 is in a substantially vertical position, and the structure 1 has been moved so that the spar 80 is positioned between the pontoons 3, 4 ready to begin the upending process.

The pontoons 3, 4 may alternatively be connected to the first and second ends of the barge 2 as shown in Figures 13 and 14.

In the embodiments shown in Figures 13 and 14, the barge 2 is connected to pontoon 3 by means of a rocker hinge 120. Winches are positioned on the pontoon 4 and extend to a front end of the barge 2. A second winch 130 is positioned on pontoon 3 and is attached to a top end of the spar 80.

The process of upending the spar 80 is similar to that described hereinabove in connection with the first embodiment of the invention shown in Figures 1 to 11.

Figure 15 is a schematic representation of the barge in the structure described hereinabove with reference to Figures 13 and 14. The barge 2 is in a substantially vertical position

ready to engage with the spar 80 of the upending process.

Although the present invention has been described primarily in relation to moving a spar it is to be understood that the invention may be used to upend and transport any elongate offshore structure.

CLAIMS

1. Transport means for transporting an offshore structure from a first location to a second location, the transport means comprising:

support means for supporting the structure, the support means adapted to float in the water having a first end and a second end, and being supported by a pontoon, the support means being pivotably attachable to the pontoon at a pivot point positioned towards the first end of the support means.

2. Transport means according to claim 1 wherein the support means comprises a barge.

3. Transport means according to claim 2 wherein the barge comprises chambers adapted to hold the fluid whereby when fluid is flooded into the chambers, the second end of the barge is caused to sink into the water.

4. A transport means according to claim 3 wherein the fluid comprises water.

5. A transport means according to any one of the preceding claims wherein the support means comprises a grillage on the surface of the barge which is contactable with the structure.

6. A transport means according to any one of the preceding claims wherein the barge is supported by two pontoons.

7. A transport means according to claim 6 wherein the pontoons are positionable at either side of the barge.

8. A transport means according to claim 6 wherein the pontoons are positionable at either end of the barge.

9. A transport means according to any one of the preceding claims wherein the barge is attached pivotably to the pontoons by means of trunnions positioned towards the first end of the barge.

10. A transport means according to any one of claims 2 to 9

wherein the opposite end of the barge is attached to the pontoons by means of strand jacks or winches.

11. A method of transporting an offshore structure from a first location to a second location, the method comprising the steps of:

positioning a floating support means in the vicinity of an offshore structure;

lowering an end of the support means below the water level to engage with the lower end of the structure, raising the end of the support means with the offshore structure in order to upend the structure onto the barge for removal to a second location.

12. A transport means substantially as hereinbefore described with reference to the accompanying drawings.

13. A method substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

11

Application No: GB 9615426.5 **Examiner:** Alan Habbijam
Claims searched: 1-10&12 **Date of search:** 7 October 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7A (AAAQ, ACA, A430D, A430D1) : E1H (HEA, HEF)

Int Cl (Ed.6): B63B 35/00, 35/28, 35/44, 38/00 : E02B 17/00, 17/02

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2252996 A	(SHEFFIELD & ADAMS ENGINEERING) See especially Figs 3-6.	1-5.
X	EP 0249422 A1	(HAUGESUND MEKANISKE VERKSTED A/S) See eg Figs 8-12.	1-4.
X	EP 0214730 A2	(MCDERMOTT INTERNATIONAL) See in particular Figs 14-17.	1&2.
X	US 4683832	(DYSARZ) See especially Figs 1-9.	1-4.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.